Q1. (a) Give **two** ways in which active transport is different from facilitated diffusion.

1 .....

.....

2 .....

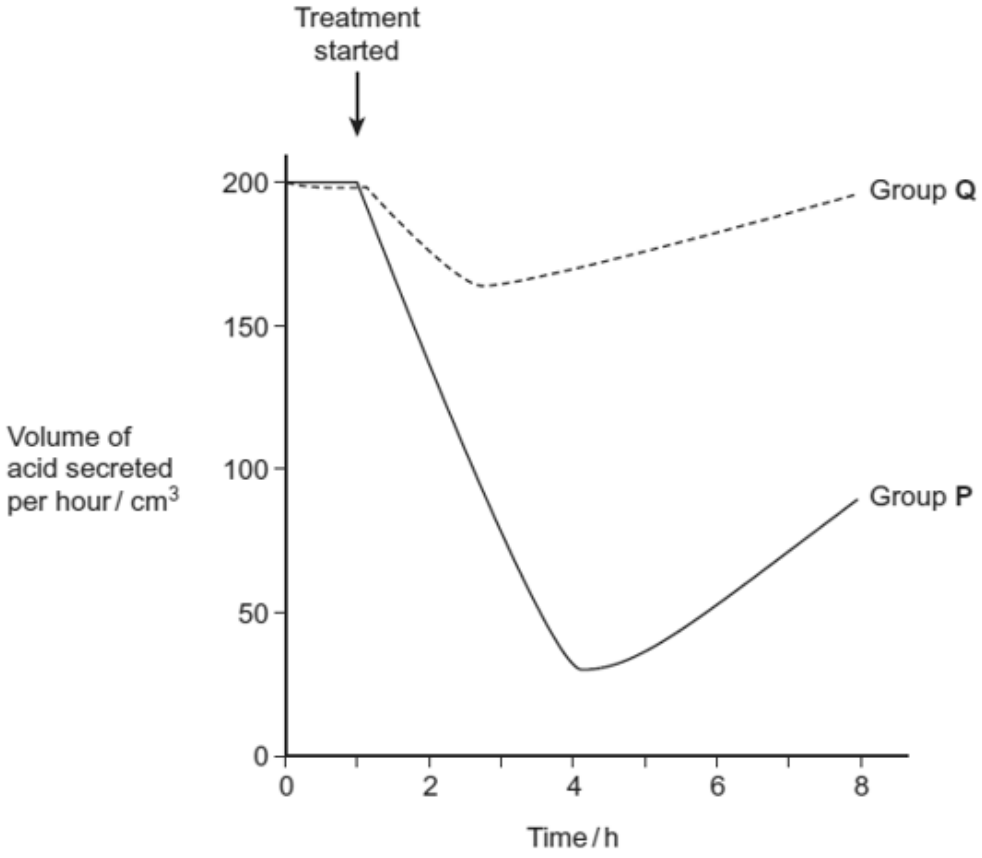
.....

(2)

Scientists investigated the effect of a drug called a proton pump inhibitor. The drug is given as a tablet to people who produce too much acid in their stomach. It binds to a carrier protein in the surface membrane of cells lining the stomach. This carrier protein usually moves hydrogen ions into the stomach by active transport.

The scientists used two groups of people in their investigation. All the people produced too much acid in their stomach. People in group **P** were given the drug. Group **Q** was the control group.

The graph shows the results.



(b) (i) The scientists used a control group in this trial. Explain why.

.....

.....

(1)

(ii) Suggest how the control group would have been treated.

.....

.....

.....

.....

(2)

(c) Describe the effect of taking the drug on acid secretion.

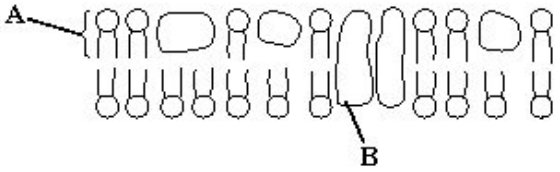
.....

.....

.....

(1)
(Total 6 marks)

Q2. (a) The diagram shows the fluid-mosaic model of a cell surface membrane.



(i) Name the molecules labelled **A** and **B**.

A .....

B .....

(1)

(ii) How does the bilayer formed by substance **A** affect entry and exit of substances into and out of a cell?

.....

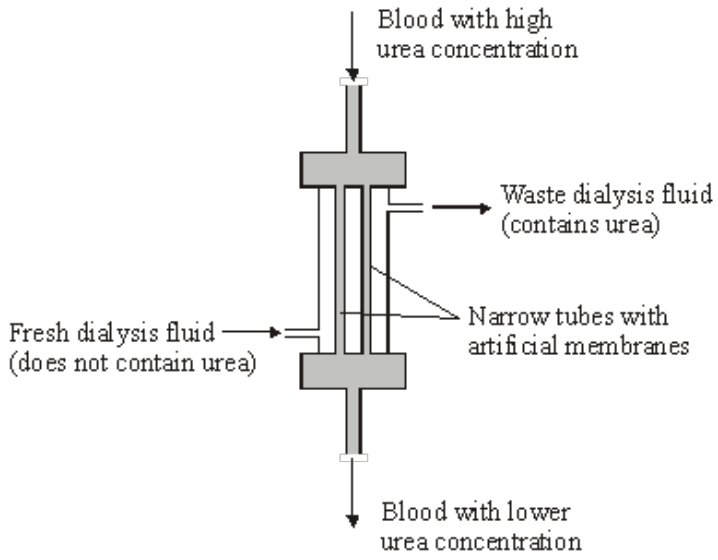
.....

.....

.....

(2)

(b) A dialysis machine contains artificial membranes which enable urea to be removed from the blood of a person with kidney failure. The diagram shows a dialysis machine.



(i) By what process does urea pass from the blood into the dialysis fluid?

.....

(1)

(ii) Suggest **two** reasons for keeping the fluid in the dialysis machine at 40 °C rather than room temperature.

1 .....

.....

2 .....

.....

(2)

(iii) The blood and the dialysis fluid flow in opposite directions in the dialysis machine. Explain the advantage of this.

.....

.....

.....

.....

(2)

(iv) Blood flows through the dialysis machine at a rate of 200 cm^3 per minute.
Calculate the total volume which passes through the machine in 5 hours.
Give your answer in dm^3 and show your working.

Answer ..... dm^3

(2)
(Total 10 marks)

Q3. A student investigated the effect of putting cylinders cut from a potato into sodium chloride solutions of different concentration. He cut cylinders from a potato and weighed each cylinder. He then placed each cylinder in a test tube. Each test tube contained a different concentration of sodium chloride solution. The tubes were left overnight. He then removed the cylinders from the solutions and reweighed them.

(a) Before reweighing, the student blotted dry the outside of each cylinder. Explain why.

.....

.....

.....

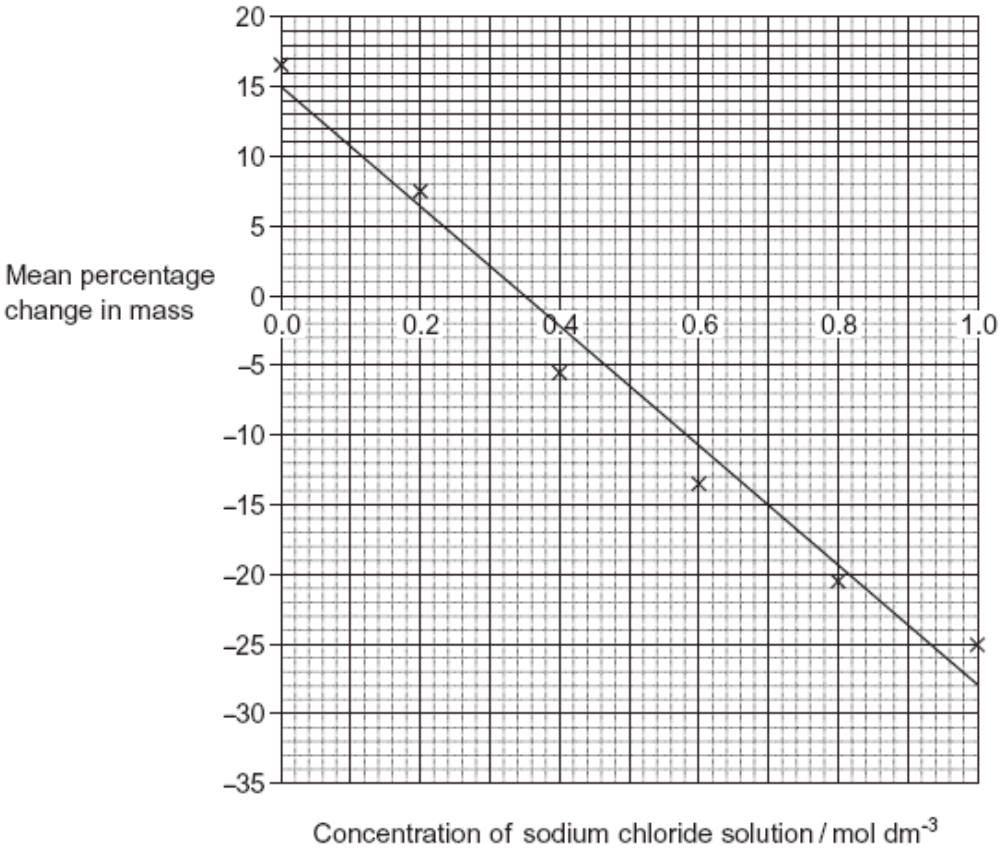
.....

.....

.....

(2)

The student repeated the experiment several times at each concentration of sodium chloride solution. His results are shown in the graph.



(b) The student made up all the sodium chloride solutions using a 1.0 mol dm^{-3} sodium chloride solution and distilled water.

Complete the table to show how he made 20 cm^3 of a 0.2 mol dm^{-3} sodium chloride solution.

Volume of 1.0 mol dm^{-3} sodium chloride solution	**Volume of distilled water**

(1)

(c) The student calculated the *percentage* change in mass rather than the change in mass. Explain the advantage of this.

.....

.....

.....

.....

.....

(2)

(d) The student carried out several repeats at each concentration of sodium chloride solution. Explain why the repeats were important.

.....

.....

.....

.....

.....

(2)

(e) Use the graph to find the concentration of sodium chloride solution that has the same water potential as the potato cylinders.

..... mol dm^{-3}

(1)

(Total 8 marks)

Q4. Students investigated the effect of different concentrations of sodium chloride solution on discs cut from an apple. They weighed each disc and then put one disc into each of a range of sodium chloride solutions of different concentrations. They left the discs in the solutions for 24 hours and then weighed them again. Their results are shown in the table.

Concentration of sodium chloride solution / mol dm^{-3}	**Mass of disc at start / g**	**Mass of disc at end / g**	**Ratio of mass at start to mass at end**
0.00	16.1	17.2	0.94
0.15	19.1	20.2	0.95
0.30	24.3	23.2	1.05
0.45	20.2	18.7	1.08
0.60	23.7	21.9	
0.75	14.9	13.7	1.09

(a) (i) Calculate the ratio of the mass at the start to the mass at the end for the disc placed in the 0.60 mol dm^{-3} sodium chloride solution.

Answer .....

(1)

(ii) The students gave their results as a ratio. What is the advantage of giving the results as a ratio?

.....

.....

.....

.....

.....

(2)

(iii) The students were advised that they could improve the reliability of their results by taking additional readings at the same concentrations of sodium chloride.

Explain how.

.....

.....

.....

.....

.....

(2)

(b) (i) The students used a graph of their results to find the sodium chloride solution with the same water potential as the apple tissue. Describe how they did this.

.....

.....

.....

.....

.....

(2)

(ii) The students were advised that they could improve their graph by taking additional readings. Explain how.

.....

.....

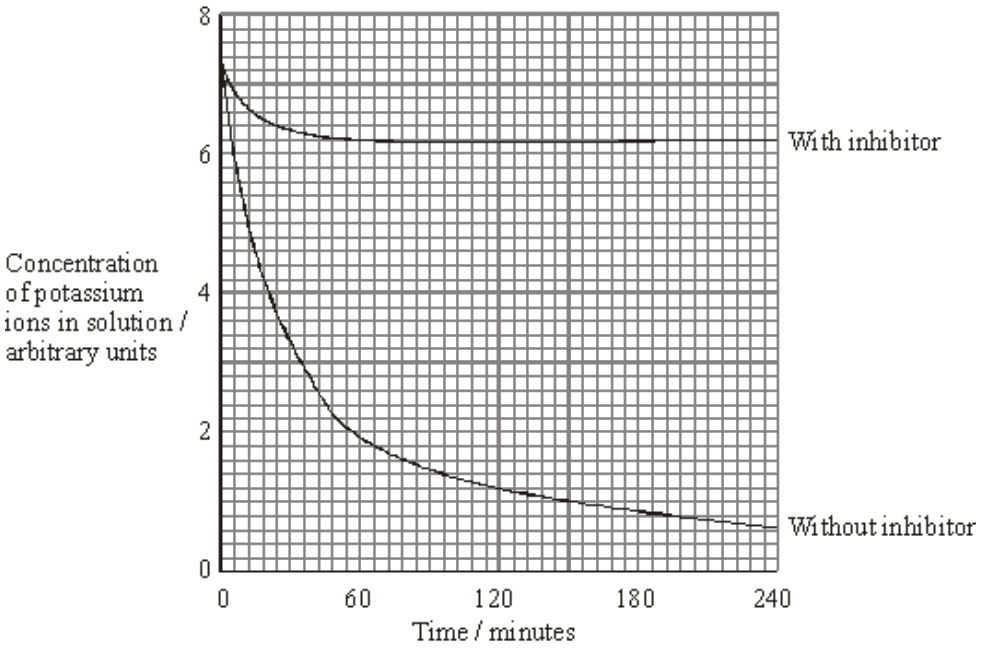
.....

.....

.....

(2)
(Total 9 marks)

Q5. Two samples of the roots of pea plants were placed in solutions containing potassium ions. An inhibitor to prevent respiration was added to one solution. The concentrations of potassium ions in the two solutions were measured at regular intervals. The graph shows the results.



(a) Explain the decrease in the concentrations of potassium ions in the two solutions between 0 and 30 minutes.

(i) With inhibitor

.....

.....

.....

.....

(2)

(ii) Without inhibitor

.....

.....

(1)

(b) Explain why there is no further decrease in the concentration of potassium ions in the solution with the inhibitor after 60 minutes.

.....

.....

.....

.....

(2)

(c) The substance malonate is an inhibitor of respiration. It has a structure very similar to the substrate of an enzyme that catalyses one of the reactions of respiration. Explain how malonate inhibits respiration.

.....

.....

.....

.....

(2)
(Total 7 marks)

Q6. Essay

You should write your essay in continuous prose.

Your essay will be marked for its scientific accuracy.

It will also be marked for your selection of relevant material from different parts of the specification and for the quality of your written communication.

The maximum number of marks that can be awarded is

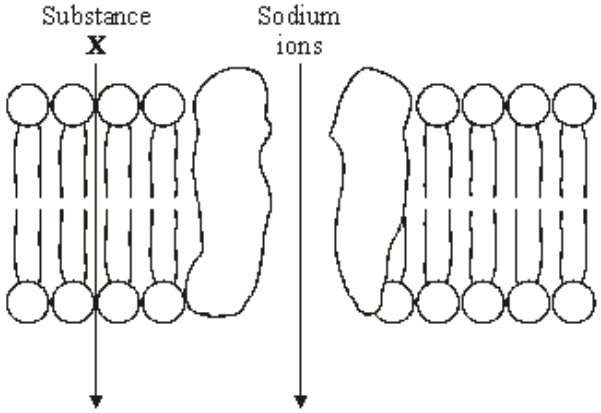
Scientific	16
Breadth of knowledge	3
Relevance	3
Quality of written communication	3

Write an essay on the following topic:

The process of osmosis and its importance to living organisms.

(Total 25 marks)

Q7. The diagram shows part of a plasma membrane. The arrows show the path taken by sodium ions and by substance **X** when they diffuse through the membrane into a cell.



(a) An optical microscope cannot be used to see a plasma membrane. Explain why.

.....

.....

.....

.....

(2)

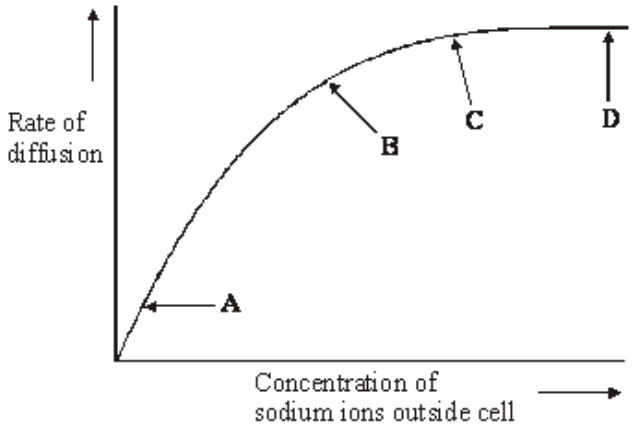
(b) Give **one** property of the molecules of substance **X** which allows them to diffuse through the membrane at the position shown.

.....

.....

(1)

(c) The effect of the concentration of sodium ions in the surrounding solution on their rate of diffusion across the membrane was investigated. The graph shows the results.



(i) What limits the diffusion of sodium ions across the membrane between **A** and **B** on the graph? Give the evidence for your answer.

Limiting factor .....

Evidence .....

.....

(2)

(ii) Explain the shape of the curve between **C** and **D**.

.....

.....

.....

.....

(2)

(Total 7 marks)

M1. (a) 1. Uses energy / ATP;

2. Against concentration gradient / low to high concentration;

3. Does not use channel proteins / <u>only</u> uses carrier proteins;

Assume "it" refers to active transport.

1. Facilitated diffusion is passive - neutral

2. Along / across concentration gradient - neutral

Accept up/down concentration gradient

Accept AT does not need concentration gradient.

2 max

(b) (i) To see the effect of the drug / effect not due to anything else in the tablet;

Neutral "to compare results"

1

(ii) Placebo / dummy drug / tablet without drug;

(Otherwise) treated the same;

No drug - neutral

Accept: Example e.g. tablet given at same time

2

(c) Decrease for 3 hours;

Accept decreases from 1 - 4 hours

1

[6]

M2. (a) (i) **A** = phospholipid

B = protein;

(both correct)

1

(ii) allows movement of lipid soluble/non-polar molecules/named e.g. water/gases;
prevents movement of water <u>soluble</u>/polar molecules/named e.g. ions / amino acids;
idea of selection / membrane partially/differentially permeable/ large molecules do not move through, small molecules do;

(accept semi-permeable)

2 max

(b) (i) diffusion

(reject facilitated)

1

(ii) higher rate of exchange/diffusion;
prevents cooling of the blood / prevents increase in viscosity;

2

(iii) concentration gradient maintained / equilibrium never achieved;
blood always meets fluid with lower concentration of urea;
diffusion/exchange along the whole length of surface;

2 max

(iv) $0.2 \times 60 = 12\ dm^3\ h^{-1}$;
(principle: volume per hour)

$12 \times 5 = 60\ dm^3$;
(correct answer 2 marks)

2

[10]

M3. (a) Water will affect the mass/only want to measure water taken up or lost;

Amount of water on cylinders varies/ensures same amount of water on outside;

Neutral: removes water
Accept: '(sodium chloride) solution' for water
Do not accept 'sodium chloride'
Neutral: refs. to fair testing

2

(b) $4\ cm^3$ (of 1.0 mol dm^{-3} sodium chloride solution) and $16\ cm^3$ (of distilled water);

Reject: factors and multiples of these figures e.g. 2 cm^3 and 8 cm^3, as final volume should be 20 cm^3

1

(c) Allows comparison/shows proportional change;

Idea that cylinders have different starting masses/weights;

Reject: if comparison is in context of the start and final mass of the same cylinder
Neutral: different masses
Neutral: different starting sizes

2

(d) (Allows) anomalies to be identified/ignored/effect of anomalies to be reduced/effect of variation in data to be minimised;

Makes the average/mean/line of best fit more reliable/allows concordant results;

Accept: 'outliers' instead of anomalies

***Q** Reject: abnormalities*

Reject: idea of not recording anomalies/preventing anomalies from occurring

Accept: 'cancels out anomalies' as bottom line response

***Q** Reject: makes the average/mean more accurate*

Neutral: makes the average/mean more valid

Neutral: makes 'it'/results/conclusion more reliable

2

(e) 0.35 (mol dm^{-3})

1

[8]

M4. (a) (i) 1.08;

Must be to 3 significant figures, as in the table

1

(ii) Allows comparison/shows proportional change;

Neutral: sizes/amounts

Idea that discs had different starting masses/weights;

Neutral: different masses

2

(iii) (Allows)

Accept: outliers instead of anomalies

Anomalies to be identified/effect of anomalies to be reduced/ effect of variation in data to be minimised;

Reject: idea of not recording anomalies/preventing anomalies from occurring

A <u>mean</u> to be calculated;

Neutral: average

2

(b) (i) Plot (sodium chloride) concentration against ratio/draw line of best fit;

Reject: if wrong axes or type of graph

Find (sodium chloride concentration from the graph) where the ratio is 1/there is no change in mass;

2

(ii) Line/curve of best fit is more reliable/precise;

Neutral: graph

Intercept/point where line crosses axis is more reliable/precise;

Reject: references to 'more accurate'

OR

Can plot SD values/error bars;

(To show) variability about the mean/how spread out the results are;

2

[9]

M5. (a) (i) absorbed by diffusion;
no energy/ATP available / active transport requires energy/ATP;

2 max

(disqualify energy made)

(allow energy reference in either (i) or (ii))

(ii) absorbed by active transport;

1

(b) (absorption by) diffusion no longer occurs / diffusion/movement of ions equal in both directions;
because no concentration/diffusion gradient / reached equilibrium;

2

(c) malonate fits into/blocks active site of enzyme / complementary to active site;
(prevents fitting neutral)
competes with substrate / is a competitive inhibitor / prevents substrate forming enzyme-substrate complex;

2

[7]

M6. ***General Principles for marking the Essay:***

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16 14 12	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
Average	10 8 6	Some of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
Poor	4 2 0	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Guidelines for marking the essay

Introduction

The essay is intended for the assessment of AO4 (Synthesis of knowledge, understanding and skills) and Quality of Written Communication (Sections 6.4 and 6.5 in the specification).
Examiners are looking for

- evidence of knowledge and understanding at a depth appropriate to A level
- selection of relevant knowledge and understanding from different areas of the specification
- coverage of the main concepts and principles that might be reasonably be expected in relation to the essay title
- connection of concepts, principles and other information from different areas in response to the essay title
- construction of an account that forms a coherent response
- clear and logical expression, using accurate specialist vocabulary appropriate to A level

Assessing Scientific Content

Maximum 16 marks.

Descriptors are divided into 3 categories:
Good (16, 14, 12), Average (10, 8, 6) and Poor (4, 2, 0).
Only even scores can be awarded, i.e. not 15, 13, etc.
Examiners need first to decide into which category an essay comes.

A good essay

- includes a level of detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- maintains appropriate depth and accuracy throughout
- avoids fundamental errors
- covers a majority of the main areas that might be expected from the essay title (These areas will be indicated in the mark scheme). (Occasionally a candidate may tackle an essay in an original or unconventional way. Such essays may be biased in a particular way, but where a high level of understanding is shown a high mark may be justified.)
- demonstrates clearly the links between principles and concepts from different areas.

Note that it is not expected that an essay must be 'perfect' or exceptionally long in order to gain maximum marks, bearing in mind the limitations on time and the pressure arising from exam conditions.

An average essay

- should include material that might be expected of C/D/E grade candidates
- is likely to have less detail and be more patchy in the depth to which areas are covered, and to omit several relevant areas
- is likely to include some errors and misunderstandings, but should have few fundamental errors
- is likely to include mainly more superficial and less explicit connections

A poor essay

- is largely below the standard expected of a grade E candidate
- shows limited knowledge and understanding of the topic
- is likely to cover only a limited number of relevant areas and may be relatively short
- is likely to provide superficial treatment of connections
- includes several errors, including some major ones

Having decided on the basic category, examiners may award the median mark, or the ones above or below the median according to whether the candidate exceeds the requirements or does not quite meet them.

Marking the essay

In marking scientific content, letters in the margin show each key area covered; these are used to assess the breadth of criteria. A single tick is used to indicate accurate coverage of each significant area, and a double tick to emphasise ‘good depth of content.’ Errors are indicated with a cross. A squiggly line in the margin is used to highlight irrelevance and ‘Q’ to highlight poor use of terminology, unclear grammar and inappropriate style.

Specific guidance for assessing Scientific Content and Breadth of Knowledge in Essays

The following provides guidance about topics which might be included in the essays. It is not an exclusive list; the assessment of scientific content does not place restrictions on topics that candidates might refer to, provided they are

- relevant;
- at an appropriate depth for A level and
- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays. In both essays, topics either from the option modules or beyond the scope of the specification should also given credit where appropriate.

The process of osmosis and its importance to living organisms

(1) definition (D)

(2) effects on cells (C)

turgity and support
plasmolysis (idea)
lysis
cystic fibrosis

(3) importance in animals (A)

role in relationship between plasma and tissue fluid
role in medulla of kidney
reabsorption in gut
sweat production neutral

(4) importance in plants (P)

role in movement of water from soil to leaves in plants
role in mass flow hypothesis for movement in plants

Breadth of knowledge

3 marks	reference to all 4 areas
2 marks	definition + 2 other areas
1 mark	any 2 areas

(b) Energy transfers which take place in living organisms

(1) ATP (A)
synthesis from ADP and P
role as an energy source

(2) photosynthesis (P)
excitation of electrons
generation of ATP and reduced NADP
photolysis
reduction of glycerate phosphate to carbohydrate
structure of chloroplast in relation to energy transfers

(3) respiration (R)
net gain of ATP in glycolysis
production of ATP in Krebs cycle
synthesis of ATP associated with electron transfer chain
ATP production in anaerobic respiration
structure of mitochondrion in relation to energy transfers

(4) uses of energy in biological processes (B)

active transport
muscle contraction
nerve transmission
synthesis
translocation
kidney function
nitrogen fixation
receptors

Breadth of knowledge

3 marks	reference to all 4 areas
2 marks	ATP + 2 other areas
1 mark	any 2 areas

M7. (a) Does not have the resolution / cannot distinguish between points this close together;
As light has longer wavelength;
The key ideas in marking this part of the question are resolution and wavelength.

2

(b) Lipid soluble / small / non-polar / not charged;

1

(c) (i) Concentration <u>of sodium ions</u> (outside cell);
As concentration/independent variable increases so does the rate of diffusion;

2

(ii) Sodium ions are passing through the channels/pores;
At their maximum rate;
Rate is limited by the number of sodium channels / another limiting factor;

max 2

[7]